APPENDIX B

Detailed Discussion of Results of the Phase II Assessment of the Fire Detection System at LANL TA-55, PF-4

National Nuclear Security Administration

BACKGROUND AND SCOPE OF ASSESSMENT

LANL TA-55 PF-4 Facility

The Plutonium Facility at TA-55 (PF-4) was designed and constructed to consolidate and update plutonium handling operations at LANL. The facility was first occupied in 1977, and DOE approval to begin operations was officially received in April 1978. PF-4 is a two-story, cast-in-place reinforced concrete structure approximately 284 ft by 265 ft in plan dimension. The height between the basement floor and the laboratory floor is approximately 18 ft. and the height from the laboratory floor to the top of the roof slab is approximately 22 ft. The laboratories are housed on the main level, and the equipment used to support their operation is contained in the basement. A 4-hour fire-rated wall divides PF-4 into two equal sections, each having its own ventilation and electrical systems. A corridor that is equipped with a set of fire doors provides access between the two halves on the first floor. Each half of the first floor is in turn divided into two processing areas by a corridor running the length of the building. Each processing area is designated as 100 area, 200 area, 300 area, or 400 area. Each area contains several rooms where process gloveboxes are located.

LANL TA-55, PF-4 Fire Detection System

The existing Fire Detection System (FDS) at TA-55, PF-4 monitors the status of various devices throughout the facility including:

- glovebox thermal detectors,
- manual fire alarm pull boxes,
- area heat detectors,
- sprinkler and hose rack flow sensing pressure switches,
- flow switches,
- smoke detectors, and
- post indicator valve assembly tamper switches.

The FDS monitored devices are divided into zones. Each zone consists of one or more of the devices listed above, and is monitored by a separate circuit. There are 199 zone circuits that provide alarm and trouble status information to the main FDS supervisory panel via jurisdictional boxes (junction boxes) and transponders. Multiple zone circuits are assigned to each jurisdictional box. There are seven transponders, each with a zone input module that can monitor up to eight jurisdictional boxes, and a command output module that provides up to four output signals to actuate facility equipment as directed by the supervisory panel. The supervisory panel is commonly referred to as the BRASS (Basic Rapid Alarm Security System) panel. The BRASS panel is part of a site wide security and fire alarm system that is monitored remotely from the facility. The BRASS panel is a microprocessor based monitoring system that uses Electrically Erasable Programmable Read Only Memory (EEPROM) firmware to process digitally coded address and status signals and generate appropriate output signals. It monitors all 199 zones, and its front cover contains trouble and alarm status lights for each zone. This panel is located in the hallway directly outside of the facility Operations Center (OC). All of the zones are scanned by the panel every 1.6 to 1.7 seconds. The BRASS panel provides direct output signals to the Central Alarm Station (CAS) via a concentrator circuit. From the CAS, located in TA-3, the alarms are forwarded to the Central Guard Station (CGS) and broadcast to the Fire Department. Alarms are also sent to the Fire Department from the Central Alarm Station via telephone circuits to printers in the Fire Stations. The BRASS panel also provides direct output signals to trouble and alarm lights and a printer in the OC, and to the PF-4 vault pre-action solenoid-operated pilot valve to charge the normally dry vault sprinkler header with water for subsequent actuation by a heat activated sprinkler head.

The BRASS panel also provides outputs via the transponders and jurisdictional boxes to local alarms, and to close drop box doors by actuating expandable thermal links (ETLs). A drop box is a vertical duct that connects a row of interconnected gloveboxes to the PF-4 overhead conveyor system which is collocated within the glovebox inlet ventilation ducting. Upon receipt of a signal from either a glovebox heat detector or a local drop box station manual pushbutton within the drop box fire detection zone, a command signal from the BRASS panel activates transponder panel relays. This causes 24V dc to be applied to the ETL, causing it to expand radially, breaking an enveloping frangible link releasing the glovebox doors (ventilation dampers) to isolate the corresponding row of gloveboxes from the normal inlet ventilation source. The BRASS panel and the transponders are provided with 24 V dc batteries and battery chargers. The batteries are provided to supply power until the diesel generator comes on line and provides power to FDS loads following a loss of normal power.

The FDS jurisdictional boxes are monitored by the Facility Control System (FCS) via Field Control Cabinets (FCCs) located throughout the facility. The FCS is a computer based data acquisition and supervisory control system that uses programmable logic controllers (PLCs) and dual communications networks (Ethernet and DH+) to transmit data. The FCS monitors facility systems including the confinement system, ventilation system, criticality alarm system, continuous air monitors, fire detection and suppression systems, electrical power distribution system, and various plant utility systems. The FCS displays FDS system status information and alarms to the operators in the OC on CRT displays, automatically performs control actions based on plant conditions as determined by system software, and allows manual control of facility systems and equipment from the OC via keyboard commands. The FCS monitors all 199 zones and BRASS panel outputs via the transponders through an interface with the jurisdictional boxes, and provides output signals when conditions warrant. The FCS generates signals that close fire doors in the PF-4 H-wall, shutdown basement ventilation system recirculation fans, open filter plenum cool-down spray valves, and sound audible fire alarms throughout PF-4 via the paging system. The FDS also monitors the Halon systems in PF-4 and the cafeteria stove hood dry chemical system.

The PF-4 FDS also serves PF-1, PF-2, PF-3, and PF-5. The original FDS was installed in 1978 when PF-4 became operational. There have not been any significant changes made to the FDS since the BRASS panel was installed in 1987.

Scope of Review for TA-55 PF-4

The scope of review for this assessment included most of the FDS equipment and components described above, including the BRASS panel EEPROM firmware. The support systems for the

FDS include the 24V dc backup batteries and associated chargers. These were included in the assessment. The TA-55 diesel generator, which ultimately provides power to the FDS on loss of normal power, was not included in the review. The FDS components included in this review are located in controlled environments inside various buildings at TA-55, including PF-4, PF-1, PF-3 and the OC. The environmental controls (i.e., heating, ventilation, and air conditioning systems) for these buildings were not included within the assessment scope.

The FCS is a separate safety system that underwent its own Phase I assessment and was not selected for Phase II assessment. Therefore this review only addressed the surveillance and testing of those safety functions initiated by the FCS based on its monitoring of the FDS, and the FCS software used to perform these functions. The FCS has an additional interface with the FDS in addition to those described above, namely to activate a Paging System audible alarm upon receipt of an alarm signal from the BRASS panel. The Paging System was not reviewed. The following additional systems that interface with the FDS were not reviewed during this assessment.

- Central Alarm Station and associated concentrator
- Halon systems

Safety Function Definition –TA-55, PF-4

Objective:

Safety basis-related technical, functional, and performance requirements for the system are identified/defined in appropriate safety documents.

Criterion 1:

Safety/Authorization Basis documents identify and describe 1) the system safety functions and the safety functions of any essential supporting systems, and 2) the system requirements and performance criteria that the system must meet to accomplish its safety functions.

Is the Criterion met?

Yes, with Opportunities for Improvement.

How the Review was Conducted:

The assessment was conducted by reviewing the Authorization Basis and other documents, attending facility briefings and tours, and interviewing facility personnel.

Documents reviewed included:

- NMT8-SDD-3200, System Design Description, Fire Detection System, 2/01/96.
- LA-CP-02-113, TA-55 Fire Hazard Analysis, April 2002.
- TA-55 Final Safety Analysis Report, 7/31/96
- LA-CP-95-169 (Rev.1), Draft TA-55 Final Safety Analysis Report, 2001
- NMT8-ASI-006-R00, Fire Alarm Initiating Device Inspection, Maintenance, and Testing, 10/19/99
- NMT8-ASI-020-R00.3, Non PF-4 FSS Flow, Main Drain And Alarm Surveillance, 5/9/01.
- NMT8-TSR-005-R03.2, Transient Combustible Control Inspection, 4/16/01.
- NMT8-TSR-203-R00.1, Site Audible Alarm Test, 3/16/01.
- Safety Evaluation Report, Revision 1, December 1996.

Facility Tours:

- TA-55, Plutonium Facility (PF-4) – General orientation tour to locate and view the Fire Detection System (FDS) components.

Interviews:

- Authorization Basis Group Leader (GL)
- Authorization Basis Deputy GL

Discussion of Results:

The review of the above documents identified the following requirements concerning the safety functions of the TA-55, PF-4 sprinkler system:

- The fire detection system will detect a fire in PF-4, and generate signals indicating the presence and location of fire.
- The PF-4 system will communicate audible and visual signals between field devices and the main control panel. Visual signals appear on monitor screens in the Operations Center (OC) and at the CAS.
- The FDS will alert the TA-55 OC/FCS to off normal or emergency situations that could require immediate response, including heat detection, smoke detection, and water flow. This action causes the FCS to close fire doors at the basement and main floor H wall and to turn off the corresponding Ventilation System re-circulation fans. The FCS will also signal the paging system to sound appropriate alarms when an FDS sensor activates and the OC will also use the paging system to provide evacuation instructions to workers.
- The FDS heat detectors in Glove Boxes served by a Drop Box, when activated, will actuate the fire damper located in the Drop Box.
- Both photoelectric and ionization type smoke detectors in the OC and vault rooms will initiate alarms as appropriate.
- Flow from any sprinkler sensed by a flow switch or pressure switch will cause an alarm to the supervisory panel of the FDS.
- Flow switches on the cool-down sprays provide input signals to the supervisory panels in the FDS.
- Early warning heat detectors are mounted at the vault corridor ceilings, which will initiate appropriate alarms.
- The Switchgear/Motor Control Rooms have photoelectric and ionization type smoke detectors mounted at the ceilings which activate Halon systems with an 18 second delay.
- Heat detectors and manual pull stations in Switchgear/Motor Control Rooms immediately activate Halon systems.
- Heat detectors at the vault ceiling activate the pre-action water control valve.

To perform the above safety functions, the following equipment is required to be operational:

- Damper doors
- Heat detectors
- Smoke detectors
- Audible signal device
- Transponders
- Releasing Devices (close dampers, close fire doors, etc.)
- Electrical Distribution System and backup power system components
- Flow sensing pressure switches
- Supervisory Panel 3225
- Jurisdictional boxes
- Vault pre-action solenoid pilot valve

The following additional equipment is required to fulfill the overall FDS safety function:

- FCS
- Paging System
- Halon System
- CAS
- Concentrators
- H-Wall fire doors
- Drop Box dampers

The following statements of System Requirements/Performance Criteria were identified from the AB documents reviewed:

- The gloveboxes have 140° F rated heat detectors mounted within wells in the glovebox ceiling. Detectors are rated at 190° F in gloveboxes with furnaces.
- Early warning heat detectors at the vault corridor ceilings are rated 135° F.
- The 190° F rated heat detectors at vault ceilings actuate the vault pre-action water control valve.
- Switchgear/Motor Control Rooms have 140° F rated heat detectors.
- Early warning 140° F rated heat detectors are installed in the duct at the entrance to the HEPA Filter Plenums.
- The drop box heat detectors as well as the basement heat detectors in the vault and switchgear rooms will activate in less than 1 minute and initiate required alarms.

The TA-55 FDS has not been identified as a safety significant SSC in the TA-55 hazard and accident analysis, FSAR, or DOE SER. Furthermore, LANL did not identify the FDS as a vital safety system under DNFSB Recommendation 2000-2. The FDS is not considered to be a significant contributor to facility safety in the facility safety basis documents because the analysis of the worst case fire scenario for PF-4 takes credit for other safety systems, such as the ventilation system, confinement system, and fire suppression system, that are classified as safety

SSCs. The operation of these other systems results in successful mitigation and dose reduction to minimal values.

Although credit is not taken for the FDS in the facility safety analysis, this system is part of the defense-in-depth safety basis for the facility. It helps to ensure worker safety in the event of a fire, and although not credited in the safety analysis, contributes to lessening the severity of the worst-case fire scenario. The LAFD response to the FDS alarm can result in the fire being extinguished sooner, resulting in less dose consequences than assumed in the analysis, and less property damage to the facility.

Facility management recognizes the safety importance of the FDS and the system is treated accordingly. The FDS is being controlled, tested, and maintained similar to a safety significant system in the areas of maintenance and configuration management discussed elsewhere in this report.

The current (1996) FSAR contains a discussion of the FDS in Chapter 2. However, this discussion has been eliminated from the copy of the draft FSAR provided to the Team. Although the FDS is not considered a safety SSC, and does not need to be included in Chapter 4 (Safety SSCs) of the FSAR, it does perform an important safety function and is part of the defense-in-depth safety basis for the facility. Therefore, the FDS should be discussed in the hazard analysis and facility description sections of the FSAR.

The FDS System Design Description was published in February 1996. It has not been revised since and appears to be out of date. For example, part of the discussion on page 14 still references the FCS FMUs (Field Multiplexer Units) that were removed and replaced with different equipment when the FCS was upgraded several years ago. In addition, while the SDD contains other information that is valuable and accurate, it appears to be incomplete. It does not contain a system diagram or basis information for system requirements, and page 12 of the SDD contains questions about the FDS design that apparently were intended to be answered, but never were.

<u>System Operability Issues or Concerns:</u> None

<u>Opportunities for Improvement:</u>

- Update the FDS SDD to ensure that it is consistent with the installed design and that it contains the information necessary to be a useful document for controlling changes to the FDS, and understanding the basis for FDS design, maintenance, surveillance, and testing activities.

- Ensure that the FDS is appropriately discussed in the FSAR.

Configuration Management - TA-55, PF-4 Fire Detection System

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criterion 1:

Changes to system safety basis requirements, documents, and installed components are designed, reviewed, approved, implemented, tested, and documented in accordance with controlled procedures. Consistency is maintained among system requirements and performance criteria, installed system equipment and components, and associated documents as changes are made.

Criterion 3:

Changes to system safety basis requirements, documents, and installed components conform to the approved safety/authorization basis (safety envelope) for the facility, and the appropriate change approval authority is determined using the Unreviewed Safety Question (USQ) process.

Criterion 4:

Facility procedures ensure that changes to the system safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.

Criteria 1, 3, and 4 are addressed together below.

Are the Criteria met?

Yes

How the Review was Conducted:

The Team reviewed safety basis-related requirements, documents, and installed fire detection system components. Interviews were conducted with facility management and engineering support personnel.

The following procedures controlling the TA-55 change process were reviewed:

- LIR220-01-01, Construction Project Management
- LIR230-01-02, Graded Approach of Facility Work
- LIR230-03-01, Facility Management Work Control
- LIR230-04-01, Laboratory Maintenance Management Program
- LIR240-01-01, Facility Configuration Management
- NMT-AP-003, Records Management

- NMT-AP-029, Design Changes
- NMT-AP-017, Work Control
- NMT-AP-027, Unreviewed Safety Question Screening Determination
- NMT-MAN-002, Design Control Manual

Fire protection detection system modifications installed since original facility construction were reviewed. Design drawings were compared to the as-built drawings 55Y-001843 Sheets 1 through 33, *TA-55 As-Built Fire Detection Systems Bldg. PF-4 TA-55*. Specific modifications to the system safety basis requirements, documents, and installed components were then reviewed to ensure compliance with the approved safety/authorization basis (safety envelope), and modification packages were reviewed to ascertain how the change approval authority was determined.

Discussion of Results:

Changes to the TA-55 Fire Detection System are developed, reviewed, approved and tracked to completion. This process is specified in a formal procedure, NMT-AP-029, *Design Changes*. NMT-AP-029 was issued on January 2, 2002 and superceded NMT13-AP-36, *Design Change Procedure* in its entirety.

NMT-AP-029 provides the necessary direction for processing Fire Detection System changes to ensure the safe and efficient implementation of modifications to the system. Requested changes are classified as minor or major and are also graded by management level (ML), complexity, and associated risk.

Once a proposed change to the system is categorized, a design package is prepared in accordance with the guidance provided in NMT-MAN-002, *Design Control Manual*. All records generated during the design change process are dispositioned in accordance with NMT-AP-003, *Records Management*.

NMT-AP-029 also requires affected documentation to be appropriately revised or prepared to reflect changes to the Fire Detection System. The procedure ensures the following configuration control activities are completed prior to approving the change for operation:

- Updating of the design document\index,
- Disposition of all nonconformance reports,
- Resolution of all field change requests,
- Execution of all regulatory and DOE approvals,
- Redlining of all priority drawings to reflect the as-built condition,
- Development of all operational procedures,
- Conduct of all preoperational training,
- Identification of post-operational procedures and training, and
- Conduct of required readiness reviews.

Additionally, prior to final closeout of a major design change, updates of the following design documents must be completed to ensure sustained configuration control of fire detection system structures, systems and components:

- Master Equipment List Data Sheets
- As-Built Drawings
- Design Drawings
- Design Documents Index Documents
- System Design Descriptions and System Data Sheets
- Operations and Maintenance Manuals
- SAR/BIO Revision Notices
- PM Program

Configuration control of the fire detection system during the performance of maintenance activities is ensured by NMT-AP-017, *Work Control.* NMT-AP-017 provides administrative controls and requires the use or development of instructions and procedures to control work such that vital fire protection systems, structures and components are not adversely impacted.

The "As-Built" Fire Detection System in TA-55 is depicted in Drawing No. 55Y-001843 Sheets 1 through 33. This series of drawing sheets provide the comprehensive configuration of the Fire Detection System in TA-55, which includes Areas A through P in both the basement and on first floor of the facility.

The analysis of the potential impact of proposed changes to the fire detection system on the facility safety envelope are screened in accordance with NMT-AP-027, *Unreviewed Safety Question Screening Determination.* The process NMT-AP-027 ensures that changes are adequately integrated and coordinated with those organizations affected by the change.

The review of recent system modifications revealed that the USQD process is being used at the facility in accordance with approved procedures.

NMT-AP-029, *Design Changes* provides administrative directions for processing changes to the PF-4 fire detection system to ensure the safe and efficient implementation of system design modifications. The NMT-AP-029 process ensures that changes are adequately integrated and coordinated with those organizations affected by the change. Interviews with FWO-FIRE personnel revealed that changes to the fire detection system components, safety basis and documents are communicated to and reviewed by FWO-FIRE.

<u>System Operability Issues or Concerns</u>: None

Criterion 2:

Limited technical walk down of selected system components verifies that the actual physical configuration of these components conforms to documented design and safety basis documents for the system.

Is the Criterion met?

Yes, with Opportunity for Improvement.

How the Review was Conducted:

The Team initially conducted reviews of the TA-55 FHA and SAR to determine specific FDS system requirements that should be reflected in the as-built facility. Then interviews were conducted with facility management and technical support personnel to identify the as-built drawing set for the fire detection system. Once the as-built set of drawings was determined, specific drawings were selected for configuration walk down to verify that the actual physical configuration of fire detection system, components and structures conformed to the documented design and safety basis documents for the system. Selected design and as-built drawings were then compared to the as-built configuration of the system. Finally, portions of Drawing No. 55Y-001843 Sheets 1 through 33 were selected for as-built configuration management walk-down.

Discussion of Results:

During the walk down, it was noted that fire detection system components were well labeled. However, several inconsistencies were identified between the actual physical configuration of the fire detection system and the as-built system Drawing No. 55Y-001843 Sheets 1 through 33. All discrepancies, listed below, involved fire detection components installed in the plant that were not shown on the drawings.

- Halon alarm bells located inside and outside of room 112 are not shown on Drawing No. 55Y-001843 Sheets 4 of 33
- Two thermal detectors XTS 500A and 501A located inside the vault entrance Room 16 are not shown on Drawing No. 55Y-001843 Sheets 9 of 33
- Four thermal detectors XTS 703 A, B, C & D located inside Room 33 are not shown on Drawing No. 55Y-001843 Sheets 15 of 33
- The conveyor tunnel fusible link (XFL unknown) located inside Room 129 is not shown on Drawing No. 55Y-001843 Sheets 25 of 33

System Operability Issues or Concerns: None

Opportunity for Improvement:

- Resolve the specific drawing discrepancies identified and consider the safety benefit of conducting a comprehensive verification walk down of Drawing No. 55Y-001843 to ensure that all discrepancies are identified and corrected. While it is typically not cost-effective to update drawings every time a change is made, especially if the change is minor and simple in nature, it is important to ensure that the system configuration is known, understood, and well documented. System drawings need to be updated as necessary to ensure that they, in conjunction with accurate change information, are usable. Drawing No. 55Y-001843 along with the FDS SDD (discussed under Objective 1, Safety Function Definition) should be updated as necessary so that the users of these documents (e.g., System Engineers, Design Engineers, Operators, etc.) can make informed and correct decisions regarding system design, operation, and maintenance.

Noteworthy Practice:

- The fire detection system is well labeled and contributes to ensuring proper configuration of the facility's structures, systems and components.

Criterion 5:

Software used in system instrumentation and control (I&C) components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Is the Criterion met?

No

How the Review was Conducted:

This review was conducted by interview of key staff members of the NMT-8 Engineering organization and the Johnson Controls of Northern New Mexico organization, review of relevant documents associated with the Fire Detection System and the Facility Control System, and observation of TA-55 facilities and work in progress.

Interviews: Fire Detection System

- NMT-8 Systems Engineering Team Leader
- NMT-8 Fire Protection Systems System Engineer
- NMT-8 Fire Protection Technician
- Johnson Controls Northern New Mexico, Superintendent

Documents: Fire Detection System

- Los Alamos National Laboratory Nuclear Materials Technology Division TA-55 FSAR, dated July 31, 1996 (controlled document)
- Los Alamos National Laboratory Nuclear Materials Technology Division TA-55 Final Safety Analysis Report, draft revision 1 (document to be controlled when issued)
- NMT8-SDD-3200, NMT-8 System Design Description, *Fire Detection System*, revision 0, dated February 1, 1996 (controlled document)
- Autocall Division, Federal Signal Corporation, Fire Alarm System Data Manual that reflects installation of the Autocall 3225 panel as described in Work Order 6-8108-65 (UNCONTROLLED DOCUMENT)
- BRASS PANEL 3225 EEPROM PROGRAMMING, undated document generated by JCNNM that describes the EEPROM programming that occurred on or about April 8, 1992 (UNCONTROLLED DOCUMENT)

- NMT8-FO1-060-R00, NMT-8 Instruction, Fire (BRASS) Pane 3225, *Maintenance Alignment,* dated March 7, 2001 (controlled document)
- NMT8-ASI-006-R00, NMT-8 Instruction, *Fire Alarm Initiating Device Inspection, Maintenance, and Testing*, dated October 19, 1999 (controlled document)
- 55-0003, TA-55 PF-0003 Control Number BRASS 3225-000, Zone/Tech Area/BLDG/Zone Information, Revision 06/06/00 (UNCONTROLLED JCNNM DOCUMENT)
- NMT8-AP-202,R0, NMT-8 Administrative Procedure, Facility Operations Group (NMT-8) Roles and Responsibilities Plan, dated August 2, 2001 (controlled document)
- Training and Qualification documentation for the NMT-8 Systems Engineering Team Leader, NMT-8 Fire Protection Systems System Engineer, NMT-8 Fire Protection Technician, and the Johnson Controls Northern New Mexico, Superintendent

Interviews: Facility Control System

- NMT-8 Systems Engineering Team Leader
- NMT-8 Lead I&C Systems Engineer
- NMT-8 I&C Engineer
- NMT-8 Quality and Records Team Leader

Documents: Facility Control System:

- Los Alamos National Laboratory Nuclear Materials Technology Division TA-55 FSAR, dated July 31, 1996 (controlled document)
- Los Alamos National Laboratory Nuclear Materials Technology Division TA-55 Final Safety Analysis Report, draft revision 1 (document to be controlled when issued)
- NMT8-SDD-5211-01 System Design Description, Facility Control System TA-55, LANL, Revision # not specified, undated (controlled document)
- NMT8 –SDD-5211-02, *NMT-8 System Design Description, TA-55 Facility Control System PLC Software Design Description*, dated March 24, 1999 (controlled document)
- NMT8-PLAN-001,R1, NMT-8 Plan, *TA-55 Facilities Control System (FCS) Software Configuration Management Plan*, dated April 2, 2002 (controlled document)
- TA-55 Change Control Manual, Section 5: TA-55 Facility Control System Software Changes, undated (controlled document)
- TA-55 Change Control Manual, Section 12, Design Change Package, Part 1, Authorization of Procurement and Construction, undated (controlled document)
- Field Change Request, DCP-096-045, FCR-129, Upgrade SCADA Software for Human-Machine Interface in the TA-55 Operations Center, dated April 24, 1998 (controlled document)
- Field Change Request, DCP-096-045, FCR-133, Install Year 2000 Patches for the SCADA Software Interface for the FCS, dated August 3, 1999 (controlled document)
- Field Change Request, DCP-096-045, FCR-134, Upgrade SCADA Software for HSI Upgrade, dated February 9, 2000 (controlled document)
- NMT-AP-029,R0, NMT-Division Administrative Procedure, *Design Changes*, dated January 2, 2002 (controlled document)

- NMT-MAN-002,R0.1, NMT Division Manual, *Design Control Manual*, dated march 29, 2002 (controlled document)
- NMTS-AP-202,R0, NMT-8 Administrative Procedure, Facility Operations Group (NMT-8) Roles and Responsibilities Plan, dated August 2, 2001 (controlled document)
- Training and Qualification documentation for the NMT-8 Systems Engineering Team Leader, NMT-8 Lead I&C Systems Engineer, NMT-8 I&C Engineer

Discussion of Results:

Fire Detection System (FDS)

The FDS is described in the 1996 TA-55 FSAR Chapter 2 as a Safety Support System. The FDS is not listed in the draft 2001 TA-55 FSAR. The FDS is also described in NMT8-SDD-3200, *NMT-8 System Design Description, Fire Detection System*, as not being a safety class or safety significant system and as having no safety class or safety significant functions. The SDD further states that the FDS, specifically Supervisory Panel 3225 in Building PF-3, including all supervised circuits, performs the mission critical function of fire detection monitoring within the primary buildings and mission-critical areas of the TA-55 facility. TA-55 Management has chosen to operate and maintain the mission-critical aspects of the FDS in a manner similar to that applied to a safety significant system (discussed in greater detail in the System Maintenance section of this report). This assessment addresses only Panel 3225 in Building PF-3 and all circuits supervised by this panel.

The SDD commits NMT-8 to construct, wire, and test FDS system assemblies in accordance with all applicable sections of the National Electrical Code and the latest versions of codes and standards issued by these organizations:

- American National Standards Institute, Inc.
- National Electrical Manufacturers Association
- Institute of Electrical and Electronics Engineers

While the SDD made the above code and standard commitments, interviews with TA-55 personnel revealed that the current practice is only to comply with NFPA 72, *National Fire Alarm Code.*

It should be noted that the FDS SDD is not current and does not accurately reflect portions of the FDS as discussed in the Safety Function Definition and Configuration Management sections of this report.

Key personnel associated with the FDS include the NMT-8 Systems Engineering Team Leader, the NMT-8 Fire Protection Systems System Engineer, the NMT-8 Fire Protection Technician, and the JCNNM Superintendent. The Systems Engineering Team Leader holds a B.S., in Architectural Engineering, an M.S. in Civil Engineering, and is a registered professional engineer. The Fire Protection Systems System Engineer holds a B.S. in Mechanical Engineering, an M.A. in Organizational Management, and is a Professional Engineer. The Fire Protection Technician has served in this role for approximately 8 years. During his tenure as Fire Protection Technician, he has successfully completed numerous LANL fire protection related courses and on the job training activities. The JCNNM Superintendent has served in various fire protection systems related roles at LANL for 17 years, since 1985. From 1975 to 1985 he held various positions, including design, at Federal Signal Corporation. During his tenure at Federal Signal, the JCNNM Superintendent participated in the design, sale, and service of the Autocall model CD-AX-2 panel used as BRASS panel 3225. The above information in conjunction with personnel interviews and review of resumes, transcripts of past training, and personal development planning documents applicable to these individuals concludes that it is appropriate for TA-55 to rely on these individuals to perform their current roles related to FDS.

Software concerns with the FDS are limited to the Electrically Erasable Programmable Read-only Memory (EEPROM) chip mounted in Panel 3225. This EEPROM, when properly programmed and installed in Panel 3225 can be considered to be firmware. Firmware is defined in IEEE 7-4.3.2-1993, *IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations*, as the combination of software and data that reside on read-only memory. Classification of the Panel 3225 EEPROM as firmware means a properly programmed and installed EEPROM can be treated as an integral part of the panel hardware. This allows the EEPROM programming to be part of the verification that the panel is functioning properly, rather than subjecting the EEPROM to a full suite of software QA controls. The TA-55 organization has implemented this approach to ensure the programming of Panel 3225 is adequate for at least a decade.

In the case of Panel 3225, the EEPROM programming was last changed in April of 1992. At the time of this assessment, records of the 1992 EEPROM programming effort were not readily retrievable. Interview of the JCNNM Superintendent revealed that the following process occurred in 1992 and on the previous occasions requiring reprogramming of Panel 3225 EEPROMs:

1. The TA-55 organization initiated a work request to change the EEPROM programming.
2. The JCNNM Superintendent responded by providing the TA-55 engineering organization with a copy of the uncontrolled document that described the previous EEPROM programming marked to show JCNNM's understanding of the desired new EEPROM programming.
3. The TA-55 engineering organization and JCNNM interacted to develop and verify the new EEPROM programming instructions and develop a test program that complied with NFPA 72.
4. The JCNNM Superintendent programmed a new EEPROM with the new set of programming instructions and JCNNM personnel installed it in Panel 3225. This programming was conducted using a proprietary software program licensed for use at LANL. This software is executable format and cannot be changed by LANL personnel. JCNNM informally maintains multiple copies of this software.
5. JCNNM personnel and TA-55 personnel conducted the NFPA 72 compliant test program. The test program addressed ALL components, circuits, system operations, and site specific software functions known to be affected by the EEPROM programming and at least 10% of items not directly affected by the EEPROM programming change. The test program verified that the EEPROM caused all of the desired FDS actions and did not cause any undesired FDS actions.

6. TA-55 personnel performed their periodic Fire Detection System operability test to establish a new baseline. The title of the test performed is unknown but is believed to be the predecessor of NMT8-ASI-006, *Fire Alarm Initiating Device Inspection, Maintenance, and Testing*.
7. TA-55 management declared Panel 3225 and its supervised circuits to be operable and instituted periodic performance of the periodic Fire Detection System operability test.

The above informal process has yielded a properly programmed and properly functioning FDS in the past. However, the complete reliance on the JCNNM Superintendent as the sole resident expert is contrary to the principles of integrated safety management and should be addressed by the development of an appropriate set of controls and the qualification of additional personnel to support FDS issues.

Records of the above actions were incorporated into the LANL work control system in effect at the time of the EEPROM programming effort. While, as indicated previously, the records of the previous EEPROM programming efforts are not readily retrievable, JCNNM has informally maintained electronic copies of the most recent EEPROM programming instructions in their facilities. While records of the previous EEPROM programming activities are inadequate, records of annual performance of NMT8-ASI-006-R00 provide reasonable evidence over a period of several years that Supervisory Panel 3225 in Building PF-3, including all supervised circuits, is performing its mission critical functions properly.

While the above discussion demonstrates that Panel 3225 and its associated firmware are functioning properly at this time and has a history of performing properly, the EEPROM programming may potentially need to be revised or the current EEPROM may fail requiring immediate replacement. While the EEPROM has generally proven to be a reliable device, like any other system component, it has a finite life span that can be impacted by numerous variables. At the time of this assessment, there are no records readily available to show how Panel 3225 EEPROMS were programmed, installed, and tested in the past and there are no documented controlled procedures in place to describe an appropriate process to program, install, and test EEPROMs in the future.

To help ensure continued long-term operability and reliability of the FDS as changes are made to the system the following actions are recommended:

1. Revise NMT8-SDD-3200 to clearly state that the only microprocessor in the Fire Detection System is an electrically erasable programmable read-only memory (EEPROM) device located in Supervisory Panel 3225. Further state in the SDD that this EEPROM is considered to be firmware.
2. Evaluate the code and standard commitments in NMT8-SDD-3200 against currently available relevant codes and standards and determine the code(s) and standard(s) that should apply to Supervisory Panel 3225 at this time. Revise the code and standard commitments in NMT8-SDD-3200 to reflect the results of this evaluation.
3. Put in place a set of basic controls, e.g., procedures, manual, or a plan, that includes a basic process to identify, evaluate, and resolve operational problems associated with the Panel 3225 EEPROM. The controls thus established should provide sufficient guidance

that personnel not involved in previous revisions of the Panel 3225 EEPROM programming can identify problems associated with the EEPROM, troubleshoot EEPROM related problems, determine the need to re-program the EEPROM, successfully revise the EEPROM programming and return the panel to operable status, and demonstrate configuration management from one version of EEPROM programming to the next.

4. Retrieve the documentation that describes the 1992 EEPROM programming effort or re-create from the collective memory of personnel involved in the 1992 EEPROM programming effort a detailed description of that effort. In particular, retrieval or development of information on the post installation test program should be pursued. Enter this documentation into the current records system and provide controlled distribution to key TA-55 and JCNNM personnel.
5. Place the Autocall Division, Federal Signal Corporation, *Fire Alarm System Data Manual* that reflects installation of the Autocall 3225 panel as described in Work Order 6-8108-65 into the current records system and provide controlled distribution to key TA-55 and JCNNM personnel.
6. Enter the undated document *BRASS PANEL 3225 EEPROM PROGRAMMING* into the current records system and provide controlled distribution to key TA-55 and JCNNM personnel.
7. Place a master copy of the EEPROM programming executable software into the records system and issue a controlled copy to JCNNM. Develop a rudimentary set of instructions on use of the software, enter these instructions into the site records system, and provide controlled distribution to an appropriate number of JCNMM personnel. Train an appropriate number of JCNNM personnel to properly use the software.

Facility Control System (FCS)

The FCS is described in the 1996 TA-55 FSAR Chapter 4 as supporting the safety function of the Safety Significant Ventilation System and is therefore also considered Safety Significant. In the draft 2001 FSAR Chapter 4, the FCS is described as part of the Safety Significant Facility Ventilation System and credited as supporting that system. Neither version of the FSAR indicates that the FCS interface with the Fire Detection System supports a Safety Significant function. The *System Design Description Facility Control System TA-55, LANL* states that the FCS is a Safety Significant supporting system because it supports the ventilation system. The SDD states that the FCS performs other safety functions including the following:

1. Activating audible alarms upon detection of a fire by the FDS.
2. Closing fire doors in the affected area upon detection of a fire by the FDS.
3. Turning off ventilation supply and recirculation fans in the affected area upon detection of a fire by the FDS.
4. Opening cool-down valves in ventilation filter plenums when thermal detectors reach a predefined setpoint.
5. Manually bypassing alarms from each fire zone.

While the SDD makes no commitments to implement any codes and standards, the SDD establishes having the following software related documents:

- Computer software engineering requirements; and a
- Software description that includes software functional capabilities for the interface with the Fire Detection System.

Key personnel associated with the FCS include the NMT-8 Systems Engineering Team Leader, the NMT-8 Lead I&C Systems Engineer, and the NMT-8 I&C Engineer. The NMT-8 Systems Engineering Team Leader holds a B.S. in Architectural Engineering, an M.S. in Civil Engineering, and is a registered professional engineer. The NMT-8 Lead I&C Systems Engineer holds a B.S. in Computer Science and has partially completed a Masters Program in Chemical Engineering. He has held numerous computer science related positions at LANL since 1988 and has been the lead for the FCS since 1998. The NMT-8 I&C Engineer holds a B.S. in Computer Science and has approximately 24 years computer science experience including 4 years FCS experience. The above information in conjunction with personnel interviews and review of resumes, transcripts of past training, and personal development planning documents applicable to these individuals concludes that it is appropriate for TA-55 to rely on these individuals to perform their current roles related to FCS.

The FCS team has long recognized the need to establish and implement software QA controls. Software engineering requirements and software functional capabilities are provided in the FCS SDD. NMT8-SDD-5211-02, NMT-8 System Design Description, *TA-55 Facility Control System PLC Software Design Description*, was issued in March of 1999. A comprehensive FCS software configuration management plan (NMT8-PLAN-001, R1, NMT-8 Plan, *TA-55 Facilities Control System (FCS) Software Configuration Management Plan*) was issued in April 2002. The FCS team is currently developing a software QA plan for the FCS. Each of these documents is responsive to relevant IEEE standards. Forward progress has been impeded by the departure of one I&C Engineer approximately one year ago. To date this individual has not been replaced.

While the FCS Software Configuration Management Plan (SCMP) establishes the criteria to be met for successful configuration management, the plan invokes the *TA-55 Change Control Manual* as the tool to accomplish FCS configuration changes. The *TA-55 Change Control Manual* was the sole mechanism for making configuration changes and establishing configuration baselines prior to approval of the FCS SCMP. Section 5 of the *TA-55 Change Control Manual* provides a process for software changes that includes: design development, design verification, post modification testing, facility testing, version control, and restoration to normal operation. Recently the TA-55 Change Control Manual was superceded. Comparable guidance is now provided by NMT-MAN-002, R0.1, NMT Division Manual, *Design Control Manual* and NMT-AP-029, R0, NMT-Division Administrative Procedure, *Design Changes*.

To address the concerns identified in the above discussion, the following recommendations are provided:

1. NMT management should evaluate progress in developing and implementing the FCS software QA effort and take appropriate action to support timely implementation.
2. NMT should implement the FCS Software QA Plan in place as soon as practical.
3. NMT should revise the FCS SCMP to reflect the cancellation of the *TA-55 Change Control Manual.*

System Operability Issues or Concerns: None

Opportunities for Improvement:

Fire Detection System

- While the technical actions implemented with regard to the software driven aspects of the FDS are reasonable and appropriate for the system as currently configured, implementation of the seven recommendations listed in the discussion above will help ensure continued long-term operability and reliability of the FDS.

Facility Control System

- NMT-8 has made significant progress toward development and implementation of software controls. Implementation of the three recommendations listed in the discussion above will help enhance continued long-term operability and reliability of the FCS.

System Maintenance –TA-55, PF-4

Objective:

The system is maintained in a condition that ensures its integrity, operability and reliability.

Criterion 1:

Maintenance processes consistent with the system safety classification are in place for prescribed corrective, preventive, and predictive maintenance, and to manage the maintenance backlog.

Is the Criterion met?

Yes, with Opportunities for Improvement.

How the Review was Conducted:

The review was conducted via a walk down of the system, interviews, and review of documentation based on the DOE Phase II CRAD approach to verify that maintenance for the system satisfies system requirements and performance criteria in safety basis documents or other local agreements. Specifically, the Review Team sought to evaluate maintenance of aging system equipment and components; determine whether there are criteria in place to accommodate age-related system degradation that could affect system reliability or performance; and review the plans and schedules for monitoring, inspecting, replacing, or upgrading system components needed to maintain system integrity, including the technical basis for such plans and schedules. Finally, the Team sought to determine whether maintenance source documents such as vendor manuals, industry standards, DOE Orders, and other requirements are used as technical bases for development of system work packages.

Discussion of Results:

Chapter 10 of the 1996 SAR describes the Maintenance Program and commits to implementing the program per DOE Order 4330.4B, *Maintenance Management Program*. Procedures applicable to maintaining the Fire Detection System are listed. The draft 2001 FSAR makes similar commitments. The commitments made for implementing a maintenance history system are not fully implemented as described under System Maintenance Criterion 2 below.

With regard to the Local Agreement for NFPA-25, the Team found that no documentation was available to demonstrate implementation of the IT&M frequencies at TA-55. Although applicability of NFPA-25 is limited to alarm devices for the Fire Detection system, it also applies to the Fire Suppression System and should be fully implemented.

From the review of maintenance of aging system equipment and components and maintenance source documents, it was determined there are no criteria in place to accommodate age-related system degradation, however, such criteria have limited applicability to this system.

Procedure NMT8-ASI-006-T01, *Fire Alarm Initiating Device Inspection, Maintenance, and Testing* is a facility-specific procedure to verify operability of the fire alarm initiating devices by heat gun, smoke aerosol, or manual activation. This is a high quality procedure with the following acceptance criteria:

- Dropbox damper doors move freely and close completely
- Dropbox manual release device initiates required alarms
- Dropbox heat detectors activate in less than 1 minute and initiate required alarms
- Basement heat detectors activate in less than1 minute and initiate required alarms
- Manual pull stations activate required alarms
- Basement smoke detectors activate and initiate required alarms

Approximately 800 heat detectors are tested per this procedure. Heat detector failures are minimal. They are typically caused when a detector is bumped or from failed electrical contacts.

The fusible links used are in limited supply and are no longer manufactured. A new link using solder is planned for testing. Issues to be addressed by testing include reliability, response time, and dripping molten solder.

Procedure NMT8-TSR-303-R00.3, *PF-4 Fire Suppression Sprinkler System Surveillance*, verifies operability of the Fire Suppression System via pressure and flow testing.

The facility Maintenance Implementation Plan (MIP) was reviewed. This plan was written to DOE Order 4330.4B and approved with comments by DOE in November 2001. DOE views this MIP as being weak with substantial need for improvement. The MIP does not provide sufficient detail to verify adequate implementation of the Maintenance Program per DOE Order 4330.4B. An updated MIP has been submitted to DOE for review.

DOE is in the process of implementing DOE 433.1, *Maintenance Management Program for DOE Nuclear Facilities*, for the Maintenance Program. When implemented, the MIP should be rewritten to that Order.

Vendor data was reviewed for the Fire Panels, sufficient technical information was available to support work package development. Vendor data was requested for the battery system to review vendor recommendations for battery life expectancy. This data was not available at TA-55. However, the Fire Panel monitors the functionality of the batteries and an annual load test is performed. Available vendor data is used in the development of corrective maintenance work packages.

<u>System Operability Issues or Concerns</u>: None

<u>Opportunities for Improvement/Recommendations:</u>

- Develop an NFPA-25 implementation matrix that specifies the frequencies of IT&M for each applicable component and list the implementing procedure.

- Update the MIP to DOE O 433.1 when the Order is implemented into the UC contract.

Noteworthy Practice:

- The facility-specific procedures for inspection and testing are well written, well organized, and easy to implement.

Criterion 2:

The system is periodically walked down in accordance with maintenance requirements to assess its material condition.

Is the Criterion met?

Yes, with Opportunity for Improvement.

How the Review was Conducted:

The Team conducted a walk down inspection, interviews, and reviews of system and component history files for the past three years to:
- Verify that the system is inspected periodically according to maintenance requirements.
- Assess the material condition of the installed equipment, components, and operating conditions; identify and document any observed conditions that could challenge the ability of the system to perform its safety function (e.g., leaks, cracks, deterioration, or other degraded or abnormal conditions).
- Determine whether observed deficiencies have been identified and addressed in a facility condition assessment or deficiency tracking system.
- Determine whether excessive component failure rates were identified.
- Determine how failure rates were used in establishing priorities and schedules for maintenance or system improvement proposals.

Discussion of Results:

The scope for the System Maintenance review included three transponders and the associated back up battery systems. These were visually inspected. Two glovebox lines were inspected. No heat detectors were actually removed from glovebox wells and examined. Actuator mechanisms for glovebox fire dampers were also inspected.

The following observations were made during the walk-down: transponders and battery systems are free from damage, water and corrosion. All viewed equipment was in excellent condition.

A maintenance history program for the Fire Detection System should be limited based on the nature of the system. There have been very few incidents of failed heat detectors and no systemic failures of the fire panel data collection centers. The System Engineer was questioned regarding maintenance history and trending data. He correctly recognized that two years of Work Order records are available via the Passport Computerized Maintenance Management

System (CMMS); however, he has not retrieved those records or trended the data. Component failure rates are not identified or trended and are not used for planning maintenance activities.

System Operability Issues or Concerns: None

Opportunities for Improvement:

- Ensure that equipment performance history data/records are maintained by the System Engineer and periodically reviewed to identify trends, potential problems, or areas of concern that could affect system operation or reliability.

- Verify that inspections and tests of alarm devices satisfy NFPA-25 requirements.

System Surveillance and Testing –TA-55, PF-4

Objective:

Surveillance and testing of the safety system demonstrates that it is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.

Criterion 1:

Requirements for surveillance and testing are adequate for demonstrating overall system reliability and operability, and are linked to the technical safety basis.

Criterion 2:

Surveillance and test procedures confirm that key operating parameters for the overall system and its major components are maintained within operating limits.

Criteria 1 and 2 are discussed together below.

Are the Criteria met?

Yes, with Opportunities for Improvement.

How the Review was Conducted:

The review consisted of walk downs of selected portions of the TA-55, Fire Detection System. The Team also performed document reviews. Additionally, the Team conducted various interviews with TA-55 Facility management and staff, as well as laboratory and contract service providers.

Documents Reviewed:

- Master Equipment List SSC Hierarchy Report for System 3200
- Fire Alarm System Data Manual, Autocall Division
- E-mail: gourdoux@lanl.gov, 10:29 AM 1/3/2000-0700, NON-COMPLIANT ITM's
- E-mail: Robert D. Patterson, 0.../2002-0700, Minutes of the March25, 2002 Fire Protection Meeting
- JCNNM ADMINISTRATIVE PROCEDURE 80-10-006, CALIBRATION OF MEASURING AND TEST EQUIPMENT, REV. 0, March 21, 2001
- Occurrence Report ALO-LA-LANL-TA-55-1996-0011
- Occurrence Report ALO-LA-LANL-TA-55-1998-0007
- LLANL Nuclear Materials Technologies Division 4/09/02 Presentation
- NMTD Fire Alarm System Sketches and Representations
- LA-CP-95-169 (Rev.1) Draft FSAR
- TA-55 FSAR July31, 1994
- NMT8-F01-060-R00 Fire (BRASS) Panel 3225 Maintenance Alignment

- LIR 402-910-01.4 LANL Fire Protection Program
- NMT- AP-017. R2 Work Control
- NMT-AP-029 Design Change
- NMT-AP-020. RO NMT Division Fire Protection Program
- TA-55 Change Control Manual Rev. 3

Drawings:
- A949001
- A949002
- A949003
- A949004
- C 45815
- 2001 Completed NMT8-ASI-006-R01
- Preventive Maintenance Work Order 00050762, FCPB- (A)-Battery Bank Check

Interviews:
- FWO- Fire Protection Engineers
- TA-55 Fire Protection System Engineers
- Systems Engineering Manager
- Performance Assurance Specialist
- Group Leader NMT-8
- JCNNM Superintendent of Fire and Electrical

Discussion of Results:

Although the Fire Detection System at TA-55, PF-4 has not been categorized as a safety significant system, the facility has conservatively identified all components within the system as ML-2 within the MEL. Testing and surveillance of the systems are performed by a contract service provider, Johnson Controls of Northern New Mexico (JCNNM). At TA-55, maintenance and testing is performed in accordance with TA-55 facility specific procedures. For the tests reviewed, current testing of the system demonstrates operability. Testing procedures appear to be well written and concise with clear acceptance criteria.

The Team's review of testing and maintenance records indicate there is no formal trending of test results by TA-55, JCNNM and FWO-FIRE. However, corrective actions resulting from failed tests are tracked to closure. Without a formal trending program and an exchange of information between TA-55, JCNNM, and FWO-FIRE, component or subcomponent deficiencies that may impact reliability or operability could be missed. Additionally, there is no program in place to capture, trend, or evaluate equipment maintenance history information related to component age-related degradation. For example, JCNNM maintainers are seeing an increased number of circuit board failures due to changes in capacitor value (a direct result of aging). Although these failures are being identified, they are not being trended to determine whether there is a need to change the current approach to surveillance and testing. Additionally, there is no traceability of subcomponents such as capacitors (an expendable) used in TA-55 ML-2 components. JCNNM indicated that due to the unavailability of components from the manufacturer, circuit boards are sometimes cannibalized to maintain installed or spare circuit boards. Consequently, the composition of circuit boards used in TA-55, providing ML-2 functions, cannot be traced. Without traceability, coupled with no formal trending program, TA-55 is lacking valuable performance data. This could have a potential impact on component reliability.

As another example, JCNNM has recently noticed an increasing number of test failures associated with FCI Inc. Model MS-2 Fire Pull Stations. These failures were not identified as a result of a formal trending program. The failures appear to be due to corroded terminals and may be limited to a specific manufacturer's batch. Corrosion of fire pull box terminals has also been identified at the Hanford Site including the Plutonium Finishing Plant. LANL apparently did not receive this information. Consequently, FWO-FIRE and JCNNM were unaware of the recent pull box failures at Hanford. JCNNM is taking action to impair these devices when they are identified during routine test call-ups. However, waiting for a routine call-up to address suspect ML-2 Fire Protection components could allow a possibly degraded condition to exist for an extended period of time.

The expected service life of components is not well defined. TA-55 management and staff are aware that many components within the Fire Detection System are aged and probably near the end of their service life. TA-55, FWO-FIRE, and JCNNM do not have information that specifically identifies expected service life of components or potential aging effects on reliability or operability. Also, vendor manuals and related vendor information are either not available or are not kept current. TA-55, therefore, is without the benefit of service instruction letters or notices that could affect continued reliability or operability of the Fire Detection System. Operational experience and vendor information is particularly important when some early design and test information such as circuit and battery sizing, load calculations, UL listings for transponders, jurisdictional boxes and the fusible links (as well as test results) are not available.

Fusible links installed in the Fire Detection System are not tested. On 17 February 1996, an inadvertent actuation of the Fire Detection System caused 170 fusible links on the drop boxes to melt in PF-4. This single incident provides evidence that the system's fusible links functioned when called upon. The system's fusible links are no longer manufactured or stocked, leaving only ninety-two in TA-55 inventory. Sample testing of the links would be destructive and further deplete an un-replenishable inventory. This situation results in testing not being performed to ensure continued reliability. TA-55 has identified electrothermal links that may be an acceptable replacement for the fusible links. A USQD has been recently been approved to test the new devices.

Fuses used in the Fire Detection System are not controlled for ML-2 usage, as they are an off-the-shelf item. However, there are multiple critical characteristics associated with fuses employed in safety applications. Due to the operability and manufacturer warranty implications of improper fusing, fuses should be controlled to preserve the functionality of components such as the systems battery chargers.

There are no formal controls regarding inventory control of spare parts for the ML-2 Fire Detection System. While TA-55 maintains some Fire Detection System spare parts, JCNNM also maintains a stock of some Fire Detection spare parts. JCNNM indicated that a manual inventory would have to be conducted to determine the quantity of ML-2 and ML-3 spare parts on hand. The inventory situation is exacerbated by the age of spares and their unavailability from the manufacturer. Additionally, the Team noted that ML-2 Fire Detection System spare parts are not segregated at either TA-55 or JCNNM. Segregation of spare parts ensures that similar but unqualified components or subcomponents that may compromise a safety function are not inadvertently installed in the system.

System Operability Issues or Concerns: None

Opportunities for Improvement:

Based on the performance of required testing, the TA-55 Fire Detection System is operable. The following actions should be considered to ensure continued reliability of system components as they age.

- Trend test results and equipment maintenance history to identify reliability or operability concerns resulting from such influences as age degradation or manufacturer deficiencies then adjust testing regimes accordingly.

- Establish vendor manual controls to receive information that may impact testing regimes.

- Establish better inventory controls for ML-2 Fire Detection System spare parts.

Noteworthy Practices:

- Maintenance procedures governing Fire Alarm Device Inspection, Maintenance, and Testing were found to be exceptionally concise and usable, incorporating the Conduct of Maintenance attributes.

Criterion 3:

Instrumentation and measurement and test equipment for the system are calibrated and maintained.

Is the Criterion met?

Yes.

How the Review was Conducted:

MTE was evaluated through conducting interviews, document reviews, and walk downs by the Team at JCNNM and TA-55.

Discussion of Results:

Currently, TA-55 test procedures that call for the use of MTE require that the instruments be listed along with their expiration dates. However, if an instrument is listed without a unique identifier, traceability is lost. LANL has recently issued Notice 87 that will require listing the serial number or the unique LANL identifier to ensure traceability. TA-55 intends to update maintenance procedures to include this requirement when the FSAR and its associated SER have been issued.

System Operability Issues or Concerns: None